

What Is Claimed Is:

1. A system for reducing an OFF-current in a thin film transistor of a liquid crystal display device, comprising:

gate and data lines crossing each other;

a pixel thin film transistor including gate, source and drain electrodes, the gate electrode connected to the gate line and the source electrode connected to the data line;

a liquid crystal capacitor connected to the drain electrode of the pixel thin film transistor;

a first switch thin film transistor connected to a first end of the data line;

a second switch thin film transistor connected to a first end of the gate line;

a first voltage source electrically connected to the drain electrode of the pixel thin film transistor;

a second voltage source connected to a source electrode of the first switch thin film transistor;

a third voltage source connected to gate electrodes of the first and second switch thin film transistors; and

a fourth voltage source connected to a source electrode of the second switch thin film transistor.

2. The system according to claim 1, wherein the first voltage source supplies alternating current (AC) voltage to the drain electrode of the pixel thin film transistor.
3. The system according to claim 2, wherein the second, third, and fourth voltage sources supply direct current (DC) voltages.
4. The system according to claim 1, further comprising a storage capacitor between the drain electrode of the pixel thin film transistor and the first voltage source.
5. The system according to claim 1, further comprising an electrostatic discharge (ESD) protection circuit between the first switch thin film transistor and the data line.
6. The system according to claim 1, wherein the pixel thin film transistor and the first and second switch thin film transistors include p-type polycrystalline silicon as active layers.

7. The system according to claim 1, further comprising a gate driver integrated circuit (IC) connected to a second end of the gate line and a data driver integrated circuit (IC) electrically connected to a second end of the data line.

8. The system according to claim 7, further comprising a pass-gate thin film transistor between the data line and the data driver IC.

9. The system according to claim 1, wherein the first to fourth voltage sources are connected to a liquid crystal panel including the pixel thin film transistor and the liquid crystal capacitor by using one of tape carrier package (TCP) and flexible printed circuit (FPC).

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10. A system for reducing an OFF-current in a thin film transistor of a liquid crystal display device, comprising:

gate and data lines crossing each other;

a pixel thin film transistor including gate, source and drain electrodes, the gate electrode connected to the gate line and the source electrode connected to the data line;

a liquid crystal capacitor connected to the drain electrode of the pixel thin film transistor;

a first switch thin film transistor connected to a first end of the data line;

a second switch thin film transistor connected to a first end of the gate line;

a first voltage source electrically connected to the drain electrode of the pixel thin film transistor;

a second voltage source connected to a source electrode of the first switch thin film transistor;

a third voltage source connected to a gate electrode of the first switch thin film transistor;

a fourth voltage source connected to a source electrode of the second switch thin film transistor;

a fifth voltage source connected to a gate electrode of the second switch thin film transistor;

a multiplexing thin film transistor connected to a second end of the data line;

a gate driver integrated circuit (IC) connected to a second end of the gate line; and

a data driver integrated circuit (IC) connected to the multiplexing thin film transistor,

wherein the data driver IC includes a data driver voltage source and a multiplexing circuit signal source such that the data driver voltage source is

connected to a source electrode of the multiplexing thin film transistor and the multiplexing circuit signal source is connected to a gate electrode of the multiplexing thin film transistor.

11. The system according to claim 10, wherein the first voltage source supplies alternating current (AC) voltage to the drain electrode of the pixel thin film transistor.

12. The system according to claim 11, wherein the second, third, fourth, and fifth voltage sources supply direct current (DC) voltages.

13. The system according to claim 10, further comprising a storage capacitor between the drain electrode of the pixel thin film transistor and the first voltage source.

14. The system according to claim 10, wherein the pixel thin film transistor and the first and second thin film transistors include p-type polycrystalline silicon as active layers.

15. A system for reducing an OFF-current in a thin film transistor of a liquid crystal display device, comprising:

- gate and data lines crossing each other;
- a pixel thin film transistor including gate, source and drain electrodes, the gate electrode connected to the gate line and the source electrode connected to the data line;
- a liquid crystal capacitor connected to the drain electrode of the pixel thin film transistor;
- a switch thin film transistor connected to a first end of the gate line;
- a first voltage source electrically connected to the drain electrode of the pixel thin film transistor;
- a second voltage source connected to a source electrode of the switch thin film transistor;
- a third voltage source connected to a gate electrode of the switch thin film transistor;
- a multiplexing thin film transistor connected to an end of the data line;
- a first gate driver integrated circuit (IC) connected to the source electrode of the switch thin film transistor; and
- a data driver integrated circuit (IC) connected to the multiplexing thin film transistor,

wherein the data driver IC includes a data driver voltage source and a multiplexing circuit signal source such that the data driver voltage source is connected to a source electrode of the multiplexing thin film transistor and the multiplexing circuit signal source is connected to a gate electrode of the multiplexing thin film transistor.

16. The system according to claim 15, wherein the first voltage source supplies alternating current (AC) voltage to the drain electrode of the pixel thin film transistor.

17. The system according to claim 16, wherein the second and third voltage sources supply direct current (DC) voltages.

18. The system according to claim 15, further comprising a storage capacitor between the drain electrode of the pixel thin film transistor and the first voltage source.

19. The system according to claim 15, further comprising a second gate driver IC connected to a second end of the gate line.

20. The system according to claim 15, wherein the pixel thin film transistor and the switch thin film transistor include p-type polycrystalline silicon as active layers.

21. A method for reducing an OFF-current in a thin film transistor of a liquid crystal display device, the liquid crystal display device including gate and data lines crossing each other, a pixel thin film transistor including gate, source and drain electrodes, the gate electrode connected to the gate line and the source electrode connected to the data line, a liquid crystal capacitor connected to the drain electrode of the pixel thin film transistor, a first switch thin film transistor connected to a first end of the data line, and a second switch thin film transistor connected to a first end of the gate line, comprising the steps of:

supplying a first direct current (DC) voltage to gate electrodes of the first and second switch thin film transistors, thereby turning the first and second switch thin film transistors ON;

supplying a second DC voltage to the source electrode of the pixel thin film transistor through the first switch thin film transistor;

supplying a third DC voltage to the gate electrode of the pixel thin film transistor through the second switch thin film transistor to turn the pixel thin film transistor OFF; and

supplying an alternating current (AC) voltage to the drain electrode of the pixel thin film transistor.

22. The method according to claim 21, wherein the first DC voltage is about -8V .

23. The method according to claim 22, wherein the second DC voltage is about 0V .

24. The method according to claim 23, wherein the third DC voltage is about 25V .

25. The method according to claim 24, wherein the AC voltage has a maximum value of about $+15\text{V}$ and a minimum value of about -15V .

26. A method for reducing an OFF-current in a thin film transistor of a liquid crystal display device, the liquid crystal display device including gate and data lines crossing each other, a pixel thin film transistor including gate, source and drain electrodes, the gate electrode connected to the gate line and the source electrode connected to the data line, a liquid crystal capacitor connected to the drain electrode of the pixel thin film transistor, a first switch thin film transistor connected to a first end of the data line, a second switch thin film transistor connected to a first end of

the gate line, a multiplexing thin film transistor connected to a second end of the data line, a gate driver integrated circuit (IC) connected to a second end of the gate line, and a data driver integrated circuit (IC) connected to the multiplexing thin film transistor, comprising the steps of:

supplying a first direct current (DC) voltage to a gate electrode of the first switch thin film transistor to turn the first switch thin film transistor OFF;

supplying a second DC voltage to a gate electrode of the multiplexing thin film transistor to turn the multiplexing thin film transistor ON;

supplying a third DC voltage to the source electrode of the pixel thin film transistor through the multiplexing thin film transistor;

supplying a fourth DC voltage to a gate electrode of the second switch thin film transistor to turn the second switch thin film transistor ON;

supplying a fifth DC voltage to the gate electrode of the pixel thin film transistor through the second switch thin film transistor to turn the pixel thin film transistor OFF; and

supplying an alternating current (AC) voltage to the drain electrode of the pixel thin film transistor.

27. The method according to claim 26, wherein the first DC voltage is about 10V.

28. The method according to claim 27, wherein the second DC voltage is about -8V .
29. The method according to claim 28, wherein the third DC voltage is about 0V .
30. The method according to claim 29, wherein the fourth DC voltage is about -8V .
31. The method according to claim 30, wherein the fifth DC voltage is about 25V .
32. The method according to claim 31, wherein the AC voltage has a maximum value of about $+15\text{V}$ and a minimum value of about -15V .
33. A method for reducing an OFF-current in a thin film transistor of a liquid crystal display device, the liquid crystal display device including gate and data lines crossing each other, a pixel thin film transistor including gate, source and drain electrodes, the gate electrode connected to the gate line and the source electrode connected to the data line, a liquid crystal capacitor connected to the drain electrode of the pixel thin film transistor, a switch thin film transistor connected to a first end of the gate line, a multiplexing thin film transistor connected to an end of the data

line, a first gate driver integrated circuit (IC) connected to a source electrode of the switch thin film transistor, and a data driver integrated circuit (IC) connected to the multiplexing thin film transistor, comprising the steps of:

supplying a first direct current (DC) voltage to a gate electrode of the multiplexing thin film transistor to turn the multiplexing thin film transistor ON;

supplying a second DC voltage to the source electrode of the pixel electrode through the multiplexing thin film transistor;

supplying a third DC voltage to a gate electrode of the switch thin film transistor to turn the switch thin film transistor ON;

supplying a fourth DC voltage to the gate electrode of the pixel thin film transistor through the switch thin film transistor to turn the pixel thin film transistor OFF; and

supplying an alternating current (AC) voltage to the drain electrode of the pixel thin film transistor.

34. The method according to claim 33, wherein the liquid crystal display device further includes a second gate driver IC connected to a second end of the gate line.

35. The method according to claim 34, wherein the first DC voltage is about -8V .

36. The method according to claim 35, wherein the second DC voltage is about 0V.

37. The method according to claim 36, wherein the third DC voltage is about -8V.

38. The method according to claim 37, wherein the fourth DC voltage is about 25V.

39. The method according to claim 38, wherein the AC voltage has a maximum value of about +15V and a minimum value of about -15V.